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ABSTRACT

In an examination of the acquisition of the spatial syntax of American Sign Language (ASL), 43 children aged 3-10 years were given a range of comprehension and elicitation tests designed to analyze the subsystems involved in the corrrect use of ASL syntax. The subsystems were nominal establishment, verb agreement, and consistency of reference. The results indicate that the acquisition of ASL spatial syntax includes several stages in the learning process as well as several components learned independently. Although verb agreement with present referents is learned relatively early, complete correct verb agreement with non-present referents is learned relatively late in spite of the intermediate accomplishment of comprehension of abstract loci for non-present referents. It is suggested that research on other aspects of the acquisition of the spatial syntactic system and the development of nonlinguistic spatial cognition in deaf and hearing children will shed light on the interplay between spatial and language representation in the visual-spatial modality. (MSE)

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THE ACQUISITION OF SPATIALLY ORGANIZED SYNTAX

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1. Introduction

Research on the acquisition of American Sign Language (ASL) has shown that, for the most part, the milestones of language acquisition are reached at about the same points in the maturational timetable for deaf children natively learning ASL as for hearing children learning their first language (see Newport and Meier, in press, for a review). However, there is at least one area of the grammar of ASL for which problems remain up to and even past five years of age. The studies to be discussed in this paper were undertaken in order to examine further this aspect of the acquisition of ASL.

2. Spatial Syntax and Discourse

American Sign Language, which is the visual-gestural language used by most of the deaf community in the United States and parts of Canada, uses the hands and face as articulators for a language perceived by the eyes. The space in front of the signer is the medium in which the language is articulated. However, that space is also used in crucial ways in the grammar.

Various locus points in space are meaningfully involved in ASL grammar. For example, for referents physically present, the points at which those referents are located are used in the syntax. First person pronominal reference is thus made by the signer pointing to her own chest. Second person pronominal reference is made by pointing to the addressee's chest. Third person pronouns, when the referents are actually present, are likewise made by pointing to the appropriate persons.

Grammatical relations, such as subject and object, can be expressed in ASL using these spatial loci. If the onset location of one of a large set of inflecting verbs is made at one of these meaningful points in space, then the verb agrees with that NP as its subject; and if the endpoint location of the verb is at another such point, the verb agrees with the NP associated with that point as the direct or indirect object, depending on the verb. Some such agreeing verbs are GIVE, ASK, LOOK-AT, INFORM, and BLAME. For example, to sign 'I give you', the verb sign TO-GIVE moves from the subject referent's location to the object referent's location. For some verbs, such as 'INVITE', these relationships are reversed: the verb moves from the object location to the subject location. This verb agreement serves as the strongest kind of cue for grammatical relations. The system has been discussed by Fischer and Gough (1978), Padden (1983), and others.

For non-present referents, arbitrary loci in space can be

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identified as associated with particular NPs. This is accomplished by signing the NP at some arbitrary locus in space, such as signing '$_a$JOHN' on the right hand side[2]; or by making the sign and then pointing to the locus with the index finger, such as MOTHER $_a$INDEX. Once NPs are associated with loci in this way, the signer can then refer to these loci in space using the verb agreement system described above, in order to refer to the non-present NPs abstractly established there.

Anaphoric pronominal reference in ASL depends upon the subsequent use of these real and arbitrary loci in space. For example, after a signer has associated 'John' with a locus on her right side, she can then use her index finger (or another handshape for different kinds of reference, such as possession), pointing to that point in space, as a pronoun for John.

An important fact about this system is that it is theoretically unlimited. If there are three individuals who figure in a particular discourse situation the signer is relating, then three loci will be established in space. If there are five or seven or ten individuals, the signer could divide up the space with that many distinct loci.

Not all verbs, however, can be marked for agreement. With non-inflecting verbs, called 'Plain verbs' by Padden 1983, subject-verb-object word order usually serves to mark grammatical relations. Some examples of plain verbs are LIKE, EAT, THINK, WANT, and EXPECT.

The system that has just been described is a fixed system of reference. When a nominal has been associated with a point in the horizontal plane of signing space, it remains associated with that point throughout the discourse, in the unmarked case. However, it is also possible that the referential framework will shift, and complex shifting back and forth between frameworks is frequent. The prototypical case of a shift in the whole reference system comes in storytelling. For this reason, some people have labeled this referential shift "role playing", but it is more than the shifting of the tone of voice and speech patterns which signals a role shift in English storytelling. The shift in ASL can also be made in other contexts, for other reasons, and can even be required for some purposes.

The mechanics of the shift are as follows. Assume that John has been associated with a locus to the signer's right, Sally has been associated with a locus in front of the signer, and Mary has been associated with a locus on the signer's left. If the signer moves her body, shoulder, head, and/or eye angle so that she is facing and looking right, this triggers a change in the referential framework. Until the framework is changed again, back to the original position or to another shifted position, first person indexing (the signer pointing to her own chest) now refers to Mary. If John is Mary's addressee, he is referred to via abstract second person indexing, and Sally via a systematic new locus for third person indexing.

If the signer had been included in the original framework, she would under the shifted framework be referred to via third person

indexing. When this referential framework shift occurs, the positions to which all referents, including multiple third persons, will be shifted is predictable. There is a complex interaction between the fixed and shifting frameworks in adult ASL narratives and discourse.

3. Previous Studies

Several studies have been undertaken on the acquisition of this system in the young deaf child (see also Bellugi and Klima 1982). Richard Meier (1981, 1982) focused on the acquisition of the verb agreement system with present referents. He examined longitudinal data from three children, and experimental data from ten children ages 3 to 7. His results indicated that the child learning ASL passes through the following stages in the acquisition of verb agreement with present referents. At the two-three sign stage, around age two, children use uninflected forms without verb agreement, even in contexts where agreement is clearly required. As they learn to use the verb agreement system, children overgeneralize to use agreement with plain verbs, or to direct the movement of the verb form toward the wrong argument. By 3;0 to 3;6, the children in Meier's study correctly produced verb agreement to present referents in obligatory contexts.

Ruth Loew (1982, 1984) studied the use of indexing and shifting reference in the narratives of one deaf child. She found that at 3;1, spatial syntax for non-present referents was absent. At 3;6, some indexing was used, but loci were not explicitly established and several referents were often ungrammatically stacked at the same locus point. Correct and consistent use of these constructions in ASL discourse did not begin until age 4;9. It was also not until 4;9 that consistent association of non-present referents with abstract spatial loci was observed.

4. Present Study

In the present study, forty-three children ages three to ten were given a range of comprehension and elicitation tests for an in-depth cross-sectional examination of the acquisition of the spatial syntax of ASL. These tests were designed to tease apart the subsystems involved in the correct use of ASL syntax, including nominal establishment, verb agreement, and consistency of reference. They will be discussed in turn.

4.1 Nominal Establishment

As discussed above, Meier found that verb agreement and understanding of the loci for present referents is achieved by about three and a half, while Loew found that consistent spontaneous production of verb agreement for abstract spatial loci did not occur until almost five. Is there a cognitive difficulty in understanding the association of non-present referents with abstract loci in space, which could account for this linguistic difference between verb agreement for present and non-present referents?

In order to examine this question, we developed a Nominal Establishment comprehension task. In this test, the experimenter associates two or three nominals with abstract points in space, then asks the child to recall this association using either a 'where' or a 'what' question. For example, the experimenter might sign 'BOY $_{a}$INDEX, DOLL $_{b}$INDEX, GIRL $_{c}$INDEX'. A following question might be 'WHERE DOLL?', or 'WHAT $_{a}$INDEX?'

This test was given to 34 children ages three to ten[3]. Their results are presented in Figure 1. As can be seen, even young children can be successful on this task. The three-year-olds scored 72% correct across all of the question types, and the scores quickly rise to ceiling by age 5. Two-year-olds, however, look for present referents when presented with this task, and point around the room at real objects.

It is evident then that young (three-year-old) children understand the association of non-present nominals with abstract loci. The failure to produce them spontaneously might thus be more of a linguistic problem.

4.2 Verb Agreement Tests

Three tests were given to assess the children's comprehension of the verb agreement system with non-present referents. In two of these tests, the children were to choose the correct picture that matched the experimenter's sentence, and in the third, the children were to act out using toy figurines the action signed by the experimenter. In the two picture-choice tasks, one involved verbs which take two arguments (such as agent and patient), and one involved verbs which take only one argument.

4.2.1 Verb agreement with toys

Twenty-eight children ages 4 to 10 participated in the verb agreement test with toys. In this test, the experimenter signed a sentence which consisted of establishing two nominals with distinct loci, and a verb of action occuring between these two nominals. The children were to act out with toy figurines the action that was signed. For example, one such sentence was $_{a}$GIRAFFE, $_{b}$LION, $_{a}$KICK$_{b}$.

The results from this test are illustrated in Figure 2. At four, the children could act out the sentences correctly 67% of the time. The scores are up to 90% by age 6.

A discussion of the results from all of the verb agreement comprehension tests will follow the descriptions of these tests and their scores.

4.2.2 Verb agreement with pictures - one argument

Twenty-nine children ages 4 to 10 participated in the single argument verb agreement test with pictures. In this test, the experimenter signed a sentence which consisted of establishing two nominals with distinct loci, and an intransitive verb whose subject is one of the two nominals. The children were to choose the picture that matched the experimenter's sentence. One of the two pictures to choose from was the correct one; the other picture showed the alternate nominal doing the action. For example, one such sentence

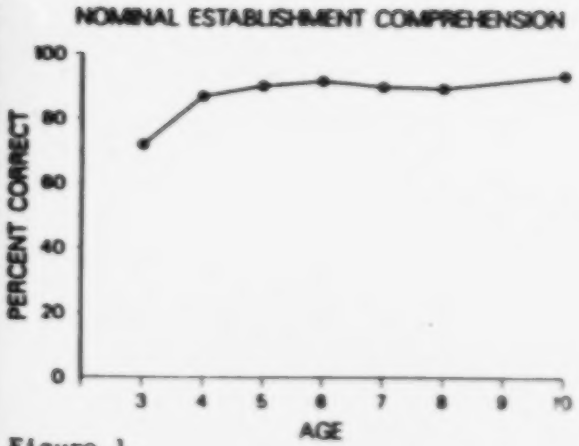

Figure 1.

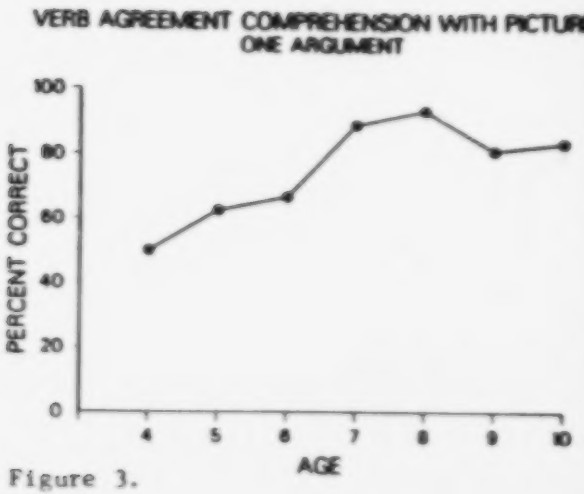

Figure 3.

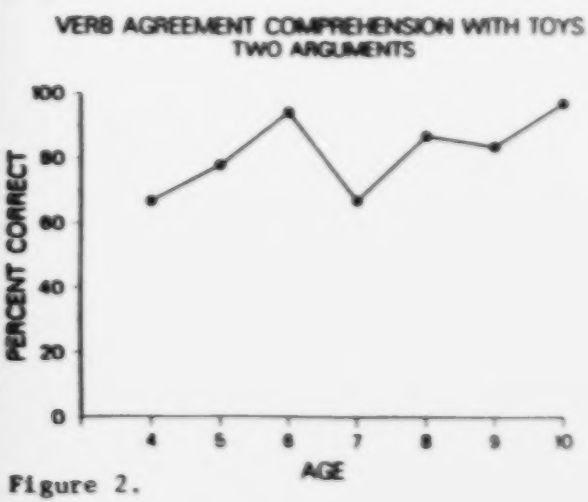

Figure 2.

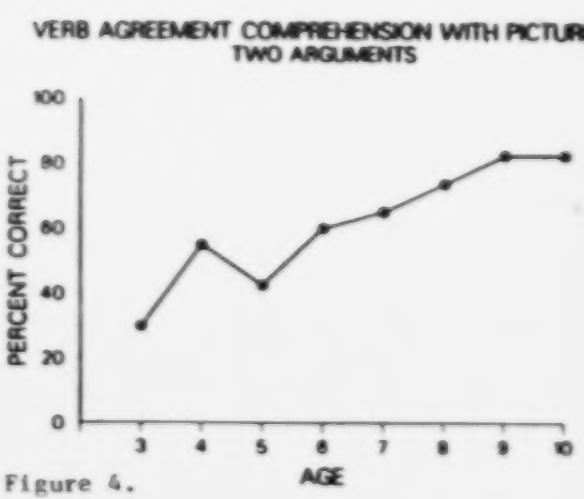

Figure 4.

was $_{a}$CAT, $_{b}$DOG, $_{a}$WALK.

The results of this test are graphed in Figure 3. The scores on this test are visibly one step behind the previous one. The four-year-olds only scored 50% correct, and it was not until age 7 that average scores over 80% were achieved.

4.2.3 Verb agreement with pictures = two arguments

Forty-three children ages 3 to 10 participated in the double argument verb agreement test with pictures. In this test, as in the immediately preceding one, the children were to choose a picture that matched a sentence which the experimenter signed. In this test, however, the action of the verb was between the two nominals that were established, as in the comprehension test with toys. For example, one such sentence was CAR $_{a}$INDEX, BOAT $_{b}$INDEX, $_{a}$CRASH$_{b}$.

The scores on this test, given in Figure 4, are the lowest of the comprehension tests given. The three-year-olds only scored 30% correct. Average scores of 60% correct were not obtained until age six, and of 80% correct not until age 9.

How can the results of these three verb agreement comprehension tests be interpreted? It is clear why each of the three tests is progressively more difficult than the one presented here before. The tests with pictures involve an extra level of decoding, to match a picture with an idea, and the tests with two arguments involve one more component of the meaning to encode. However, it is significant that each level of success on even the first verb agreement test was approximately a year later than the corresponding level of success on the nominal establishment test.

Recall that deaf children learning ASL can produce verb agreement with present referents correctly by age 3 and a half. If they understand that the verb agreement system with non-present referents is an extension of the system with present referents, then it could be predicted that they would understand this system as soon as (or quickly after) they understand the association of non-present nominals with abstract loci. However, these tests indicate that this is not the case. Rather, it seems that another stage of analysis is needed between the time that children can understand this abstract locus-assignment and the time that they can understand the verb agreement which relies on these loci.

4.3 Production test

A production task was given to elicit the use of ASL syntax. In this task story booklets were used to elicit short narratives from the children. These booklets have one picture on each page, with no words. The pictures depict a series of related events with the same participants involved.

In this task, the children were shown each picture in turn, and asked to tell what was happening in the picture. After seeing the whole book, the children were asked to tell the whole story of what happened in the book. Later on in the testing session, the children were asked to retell the stories from memory.

The results from 19 children who took this test, ages 3 to 8,

will now be discussed, focusing on the narratives told by the children immediately after having seen the whole book.

The three-year-old children used almost exclusively uninflected verb forms. They failed to establish nominals with loci, or use any of the spatial syntax. They also produced some nonce forms.

The four-year-olds also used uninflected verb forms and relied on word order to convey grammatical relations. As mentioned above, word order is used in general with plain verbs - those that do not take verb agreement marking. In most cases the use of word order and uninflected verb forms is not grammatical adult ASL, although it is understandable.

Recall that by ages three and four, these children generally do use verb agreement with present referents consistently and correctly. It is just with non-present referents that the use of uninflected forms pervades at this age.

At age five, the children in this study did use some overt nominal establishment, and correct agreement for non-present referents. However, some errors in both nominal establishment and agreement remained. In addition, some correct agreement was used without appropriate nominal establishment.

By age six, the children used verb agreement appropriately. Nominal establishment was correct, although not always used overtly. In adult signing, one way of associating a nominal with a locus is to sign that nominal, and then use a verb agreeing with that locus. The six-year-olds were then correct in using verb agreement in this way.

At age seven, the children continue to use correct verb agreement and nominal establishment. However, at this age they also use the shifting referential framework more often, in order to convey the reciprocal relations in the paint story, and they do make errors with this system. These errors usually consist in incorrectly mixing the fixed and shifting frameworks. The reciprocal relation involved requires a complex shifting back and forth between three referential frameworks.

Following is one child's attempt to integrate these complex frameworks. This child first signed BOY $_{a}$PAINT$_{c}$, using the fixed framework properly. She then signed PAINT toward her own face, as if changing to a shifting framework; however, she failed to indicate the shift appropriately and thus her signing meant 'paint on myself'. At that point, she hesitated and changed course. She assigned the role of the girl in the picture to the experimenter, assumed the role of the boy herself, and indicated painting on the experimenter's face, as if reverting to a 'real world' reference system, since she could not yet deal with the abstract reference system under the demanding circumstances of the test.

In Loew's research with one deaf child, she found some use of the shifting framework as early as three. At 4;9, the oldest that Loew's study extends, there are some appropriate framework shifts, but still errors appear. In the present study, we see that even at seven, some errors remain, with the more complicated types of shifts.

By eight years of age, the children in this study generally used

nominal establishment, verb agreement, shifting frameworks, and consistent pronominal reference correctly.

5. Conclusion

This program of study has indicated that the acquisition of spatial syntax in ASL includes several stages in the learning process, and several components which are learned independently. Although verb agreement with present referents is learned relatively early, complete correct use of verb agreement with non-present referents is delayed until relatively late. It could be suggested that the correct production of verb agreement with non-present referents is dependent on the correct production of abstract loci for non-present referents. However, the comprehension tasks discussed here have shown that at least the comprehension of abstract loci for non-present referents is accomplished well before the comprehension of verb agreement for non-present referents. Furthermore, correct production of verb agreement for non-present referents does take place without overt association of nominals with abstract loci, although the association must be implied.

One of the most interesting questions with respect to the acquisition of spoken and signed languages is the effect of the modality on the acquisition process, and the relationship between the development of language and its corequisite cognitive substrate. We are now looking at other aspects of the acquisition of the spatial syntactic system, as well as the development of nonlinguistic spatial cognition in deaf and hearing children, to study the interplay between spatial representation and language representation through a language in the visual-spatial modality.

FOOTNOTES

1. The first author is also at the University of California, San Diego. This research was supported in part by National Institutes of Health Grant #NS15175 to Dr. Ursula Bellugi at the Salk Institute. We are grateful to Dr. Henry Klopping, the faculty, staff, and students at the California School for the Deaf, Fremont, for assisting and taking part in our research.

2. Both hands are involved in signing, although they are not equivalent. Right handers usually sign with the right hand dominant; they would tend to associate a nominal with a locus on the right before one on the left. However, signing can be done with one hand only, with equal grammaticality. A relevant study on hand dominance in signing is Vaid, Schemenauer, Bellugi, and Poizner 1984.

3. There were at least three subjects in each cell for each test, expect for only two four-year-olds on the Verb Agreement with Toys and Verb Agreement with Pictures: One Argument tests. No scores were reported for three-year-olds on these two tests because only one three-year-old was given them. Currently, more subjects are being tested.

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